

CROSS

Confidential Reporting on Structural Safety

Newsletter No 5, January 2007

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INTRODUCTION

It is over a year since the first Newsletter was published and more than 60 reports have been given covering over 20 topics. This issue has reports on Responsibility for change, Balconies and balustrades, Hidden corrosion leading to failure, Timber frames, and Grades of steelwork. These represent a wide range of concerns that have affected structures and give experiences from which other engineers can benefit.

SCOSS (the Standing Committee on Structural Safety) will publish its biennial report in early summer 2007 which will contain an analysis of the reports so far and give recommendations for actions that may be taken to make best use of the information gathered. During the year CROSS plans to increase the number of reports made by contractors, and the engineers who work for them, to extend the applications of the scheme.

In December 2006 there was an International Symposium in London on Confidential Reporting Systems with representatives from schemes in Health Care, Aviation and Railways. CROSS is unique in that there are no other systems that deal with structures. The longest running scheme is ASRS (<http://asrs.arc.nasa.gov>) which has been run by NASA for the last 30 years and has received 750,000 reports on matters of aviation safety in the USA. After a slow start the number of reports climbed steadily and the scheme has become a major influence on the aviation industry worldwide.

Key features of ASRS are to:

- be non-judgmental and promote an attitude that things can be fixed,
- be seen by all sides of the industry as an honest broker,
- have stakeholder participation to provide advice and guidance,
- analyse and evaluate the subject matter and provide feed back.

It has been established that people are willing to share information if they are assured that their identities are protected and there are no disciplinary or legal consequences. CROSS is modelled on CHIRP (www.chirp.co.uk), the UK aviation and maritime system which is closely related to ASRS and NASA, and thus has a distinguished pedigree. We have a long way to go to approach the success of these schemes so more reports are needed both on topics already covered and on new topics.

CONSTRUCTION

Responsibility for change

During the construction of two three storey blocks of flats with masonry walls and pre-cast concrete floors, the contractor requested that he be allowed to substitute an alternative make of steel lintels for those specified by the structural engineer. This was agreed and a change order was issued. The replacement lintels were selected by the contractor's supplier, using equivalent loading capacity from the manufacturers' tables. The contractor did not request the Engineer to recalculate loads and confirm the specification. Because of eccentric loading and the lack of triangulation above the lintels the substitutes began to buckle and masonry cracked. The buildings, which were structurally complete at the time, had to be evacuated and propped. There was a ten week delay to the project whilst a design solution was found and implemented. The inadequate lintels were cut out and new steel members were inserted. Analysis of the situation concluded that because of the number of parties involved, both contractors and consultants, there was no clear line of responsibility for reacting to and controlling the change.

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NEWS ITEMS

Wind damage

In recent weeks there have been a number of examples of structural damage due to high winds. On 13 November 2006, it was reported that aluminum sheeting blew off the roof of a new store in Chester. A fire service spokesman said that weather conditions were quite extreme. Also in November a Welsh village was hit overnight by what was described as a small tornado. More than 20 houses were affected with roofs and chimneys blown off, while electricity cables have been brought down and trees uprooted. Hundreds of people were left homeless on 7 December after a tornado ripped through residential streets in north London. London Fire Brigade, said about 100 homes had been damaged in "freak weather". SCOTCROSS has had reports of incidents in Scotland in January 2007 including the sudden complete collapse of a 20m high steeple in high winds.

In On 18th January there were high winds across much of Europe with many deaths reported, including some due to structural collapses and some from debris being blown off buildings. Two heavy steel girders came loose from a glass facade at Berlin's new main station, one of them plunging onto an outdoor staircase. London Bridge station was closed when part of a roof collapsed and scaffolding blew down from the Saint-Omer cathedral in, France.

Are the numbers of such events increasing and if so is it because the frequency and wind speeds of storms are rising? CROSS would value more reports on structural damage caused by wind to see if there is a new trend emerging.

Comment A very large number of failures are as a result of change during the late stages of design or construction. The initiator of change needs to be very aware of the risks involved and of the difficulty in identifying accountability for structural robustness in a typical project with many parties. It frequently happens that the initiator is unaware of the potential consequences of his proposals. If the design is to be changed, then, unless the contractor is a designer i.e. he is employed on a Design and Build form of contract, or JCT with a design element, he has no mandate to design anything; it must be done by the original designer. This lack of clarity is a matter of great concern to SCOSS. It is recommended that designers engaged in a Design and Build contract keep their clients alerted to these risks. An extreme example recently was of a changed component that failed under load and a death resulted. The lesson is never to make unauthorised changes and always refer the need for a change back to the designer who must be the one to determine whether this is appropriate. A contributory cause of the 1974 Flixborough explosion was plant modification that occurred without a full assessment of the potential consequences. (Report 050)

Balustrades in public buildings

A reporter had a concern regarding a timber balustrade in a showroom. It was only 900mm high made out of 50mm x 100mm timber framing screwed down to the 38mm chipboard floor of a mezzanine. The reporter had told the owner on many occasions that the balustrade was totally inadequate but no action was taken until Building Control officers agreed to tell the building owner to make modifications to improve the balustrade.

The reporter had a second, particularly worrying, concern about new balustrades at first floor level above an assembly hall in a building under construction. Users of the space will rely upon a balustrade that, in the view of the reporter, is a totally inadequate steel frame with glazed infill panels installed by a small local fabricator. There was no apparent design input and the reporter asked if he is obliged to tell the Local Authority? He says that an episode of 'The Bill' on TV showed where a balustrade in a nightclub collapsed due to the pressure from a crowd, and this forcibly brought home the implications and the potentially dire effects of inadequate balustrades. The reporter then wrote to Building Control to say that if a satisfactory response was not received the matter would be passed to the Local Authority ombudsman and action was then taken by the Authority.

Comment There have been many examples of balustrades and barriers failing under horizontal load at football clubs and at pop concerts. In some cases there have been multiple fatalities. Designers and Local Authorities must be vigilant about the risks from inadequate barriers wherever they are. Balustrades may be inadequately designed from a structural point of view as they are often being deemed to be architectural metalwork. If an engineer has cause to fear that a structure is inadequate then the appropriate authorities should be informed. (Report 061)

FACADES

Façade failure

The building in this report is a church built as a composite masonry structure with granite cladding on the front façade. Steel RSJs are used as lintels behind the door and window openings. The steel has corroded over the years and the expansion had pushed the cladding material off. Large pieces of granite fell without warning from a 2nd floor opening.

Comment A common problem due to the corrosion of an embedded item and a matter to be watched for on existing buildings. SCOSS has previously recommended inspections of clad buildings (Alert dated May 2000) and the IStructE guide to 'Appraisal of buildings' gives good advice. The dangers of masonry and other components falling from buildings are discussed in the SCOTCROSS report that has recently been published on: www.sbsa.gov.uk/research/Research. (Report DI 063)

What should be reported?

- lessons learned which will help others
- concerns which may require industry or regulatory action
- near misses
- trends

Benefits

- unique reservoir of information
- better quality of design and construction
- possible reductions in deaths and injuries
- lower costs
- reduced concerns about liability

Founder supporters

- Association for Consultancy and Engineering
- Construction Industry Council
- Constructing Excellence
- Department of Trade and Industry
- Health & Safety Executive
- Institution of Civil Engineers
- Institution of Structural Engineers
- Department of Communities and Local Government
- Office of Government Commerce
- Scottish Building Standards Agency

Unstable building due to modification work

A SCOTCROSS report relates to an old 4 storey building undergoing modifications. Part of the rear wall at ground floor level had been removed and insufficient propping had been provided resulting in floors at first floor level moving downwards quite significantly. The building had become potentially unstable.

Comment A problem that again illustrates the need for caution when amending old buildings and one which has previously been mentioned in these Newsletters. The parties involved must be competent to undertake the task; the planning of the project should include a competent structural engineer designer to assess the sequence, interim stability and overall safety issues. The difficulty may well have been that there was no engineering input or that the builder was not experienced enough to recognize the risks. HSE and SCOSS are looking at ways of raising awareness about such problems amongst builders and DIY enthusiasts. Further reports on this topic would be welcomed and will assist with the development of guidance. (Report DI 069)

TIMBER

Timber truss

The reporter is a chartered structural engineer working in Building Standards. He has been dealing with an application where the engineer involved discovered proprietary timber girder trusses 400mm deep and spanning 7.5m @ 1.2m centres with glued joints. Some of these joints have come loose. There are apparently no mechanical fixings to the joints, with diagonal members being glued between the pairs of top and bottom chord members, and vertical members being glued at the end to the face of the top and bottom chords. It is some of the vertical members that have come loose, and others are completely missing. Some members have also been deliberately removed to allow for the passage of ducting. The girder is made up of effectively two girders of 30mm thick timber fixed either side of plywood webs which are present near supports. Outwith the ply web zones there are vertical and diagonal members, as referred to above. It is not known whose system this is, other than it appears to be a manufactured proprietary product. At a guess it dates from the 1970's. Remedial works have been instructed, involving changing the girders to ply web beams.

Comment A useful report illustrating problems that may occur when relying upon glue in older timber trusses. The removal of structural members, by those unqualified to assess the effects is, unfortunately, too common, and may indicate that timber structures are modified because it is comparatively easy to do so without realizing the potential consequences. The reporter does not state whether there was moisture present but it is known that moisture can cause non-resistant glues to deteriorate. It is thought that this was a contributory factor in the collapse of an ice rink roof in Germany in January 2006 when there were 15 fatalities. It is very important to ensure that the requirements of BS EN 14080:2005: Timber structures. Glued laminated timber. Requirements, are met fully when fabricating trusses. (Report DI 062)

Stability of timber frame construction

The reporter is a structural engineer with many years design experience in the field of timber frame construction both as a designer and a checker. When checking calculations he has noted that a common defect appears to be related to the design for overall stability. Stability is provided by timber framed racking walls sheathed in OSB (Orientated Strand Board) providing in plane resistance to lateral loading. Often the presence of large numbers of doors and windows means that external walls have insufficient racking resistance to provide overall stability on their own. Commonly, internal walls are also sheathed in OSB to provide the required lateral load resistance. Although these internal walls are designed in accordance with the British Standard in calculating the racking resistance of the wall panel, attention is not given to the overall stability, i.e. the resistance of the wall to global sliding or rotation. Since internal walls are not secured by holding down straps against uplift, as in the case of external walls, and since they often carry little or no vertical loading, their resistance to sliding and, in particular, overturning is very limited.

The reporter has seen several cases of buildings which would be potentially dangerous being proposed by experienced designers. One solution has involved steel frames being introduced into timber frame construction with special details developed to anchor internal walls to foundations and so prevent uplift and rotation.

Of further concern, in one recent case, the engineer responsible for the design of the structure admitted that it could not be justified by calculation but appeared to indicate that his client, a timber frame house supplier, was unwilling to modify to the design unless this inconsistency was picked up by a checking engineer. This statement would seem to imply a lax attitude to designing for overall stability.

Comment The importance of adequate timber design is a matter of continuing interest to SCOSS. This case, and the Colindale Fire in NW London in July 2006 when a timber framed building under construction was destroyed by fire in less than 9 minutes, highlight that there are particular hazards with timber frame construction. SCOSS has identified from other sources that the issue of robustness is a major concern. This example illustrates a number of points: lack of understanding of structural concepts, failure to appoint one competent person with overall responsibility for stability and robustness (as required by codes of practice), and a failure to take an adequate stand on matters of safety in the face of influences from lay sources. The implication that a client would not modify an unsuitable design unless this was noticed by a checker is a serious matter. If something is known to be questionable it cannot be left unresolved and in a court situation the design engineer could be deemed to have been negligent. (Report DI 051)

STEELWORK

Grades of steel

A reporter says that engineers seem reluctant to specify the grade of steel. Even when prompted, some fail to request anything other than just S275 – failing to mention JR, J0, or other grades. Back in the 1980s, most steel came from British Steel which was of high quality. However, supplies from abroad (not necessarily a bad thing) may require more precise specification, particularly for anything that is external.

Comment Comments: This report is of concern reinforcing a view that many designers do not appreciate the importance of steel properties other than the one governing strength. European standard EN 10025:2004 defines available steel grade classifications for various Charpy V-notch impact capabilities as referred to by the reporter. The reporter may be well right that many engineers are not fully aware of the demands of brittle fracture and of their responsibility to specify a grade of steel having adequate strength but also one having adequate toughness for the design circumstances. This involves selecting the correct subgrade linked to thickness and operational temperature demands. This selection is a requirement from the designer to meet the NSSS. What is of even more concern is the extrapolation to bigger jobs where the steel is welded and thicker, beyond the normal range, and operating in cold temperatures where the risks of brittle fracture became much greater. A useful reference is; W Swann: 'Is your steel tough enough? Specifying steel to BS 5950-1: 2000', *The Structural Engineer*, Vol. 83, No 21 (November 2005) and there is also a Viewpoint article 'Designing for safe construction' in *The Structural Engineer*, Vol. 84, No 10 (May 2006). (Report DI 043)

HOW TO REPORT

Please visit the web site www.scoss.co.uk/cross for more information.

When reading this Newsletter online [click here](#) to go straight to the reporting page.

Post reports to:
PO Box 174
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Comments either on the scheme, or non-confidential reports, can be sent to dir.cross@btinternet.com

DATES FOR THE PUBLICATION OF CROSS NEWSLETTERS

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| Issue No 6 | April 2007 |
| Issue No 7 | July 2007 |
| Issue No 8 | November 2007 |